



US009510773B2

(12) **United States Patent**
Srivastava

(10) **Patent No.:** **US 9,510,773 B2**
(45) **Date of Patent:** **Dec. 6, 2016**

(54) **MULTI-ELECTRODE APPPOSITION
JUDGMENT USING PRESSURE ELEMENTS**

(71) Applicant: **Medtronic Ardian Luxembourg
S.a.r.l.**, Luxembourg (LU)

(72) Inventor: **Nishant R. Srivastava**, Mountain View,
CA (US)

(73) Assignee: **Medtronic Ardian Luxembourg
S.a.r.l.**, Luxembourg (LU)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/716,167**

(22) Filed: **May 19, 2015**

(65) **Prior Publication Data**

US 2015/0335263 A1 Nov. 26, 2015

Related U.S. Application Data

(63) Continuation of application No. 13/870,172, filed on
Apr. 25, 2013, now Pat. No. 9,066,726.

(Continued)

(51) **Int. Cl.**

A61B 18/18 (2006.01)

A61B 5/06 (2006.01)

(Continued)

(52) **U.S. Cl.**

CPC **A61B 5/065** (2013.01); **A61B 5/02**
(2013.01); **A61B 17/320068** (2013.01); **A61B**
18/14 (2013.01); **A61B 18/1492** (2013.01);
A61B 18/1815 (2013.01); **A61N 1/403**
(2013.01); **A61N 5/025** (2013.01);

(Continued)

(58) **Field of Classification Search**

CPC A61B 18/1492; A61B 2018/00434;
A61B 2018/00577; A61B
2018/1435; A61B 2019/465; A61B
2018/00404; A61B 218/00511; A61B
2018/00654; A61B 2018/00214

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,602,624 A 7/1986 Naples et al.

4,649,936 A 3/1987 Ungar et al.

(Continued)

FOREIGN PATENT DOCUMENTS

WO WO9407446 4/1994

WO WO-9525472 9/1995

(Continued)

OTHER PUBLICATIONS

European Search Report for European Application No. 13159256,
Date Mailed: Oct. 17, 2013, 6 pages.

(Continued)

Primary Examiner — Michael Peffley

Assistant Examiner — Amanda Zink

(57) **ABSTRACT**

Apparatus and methods for determining positioning of a
energy delivery element include deploying a energy delivery
element at a treatment site proximal to a vessel wall; using
a multi-region pressure sensing apparatus to sense pressures
applied in a plurality of directions about the energy delivery
element; and determining an orientation of the energy deliv-
ery element based on the pressures measured in the plurality
of directions about the energy delivery element.

13 Claims, 22 Drawing Sheets

